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(54) **Tumbler Dryer**

(57) A tumbler dryer has a clothes drum mounted to rotate in a casing about a horizontal axis. The drum is driven by a motor mounted in the casing at least partially below the drum. The drum and casing have a space between their rear walls and in this space are located co-operating stationary and moving dryness sensor contacts. The moving contact is mounted on the end of the drum facing the space and is connected to a dryness sensor or sensors located in the drum.

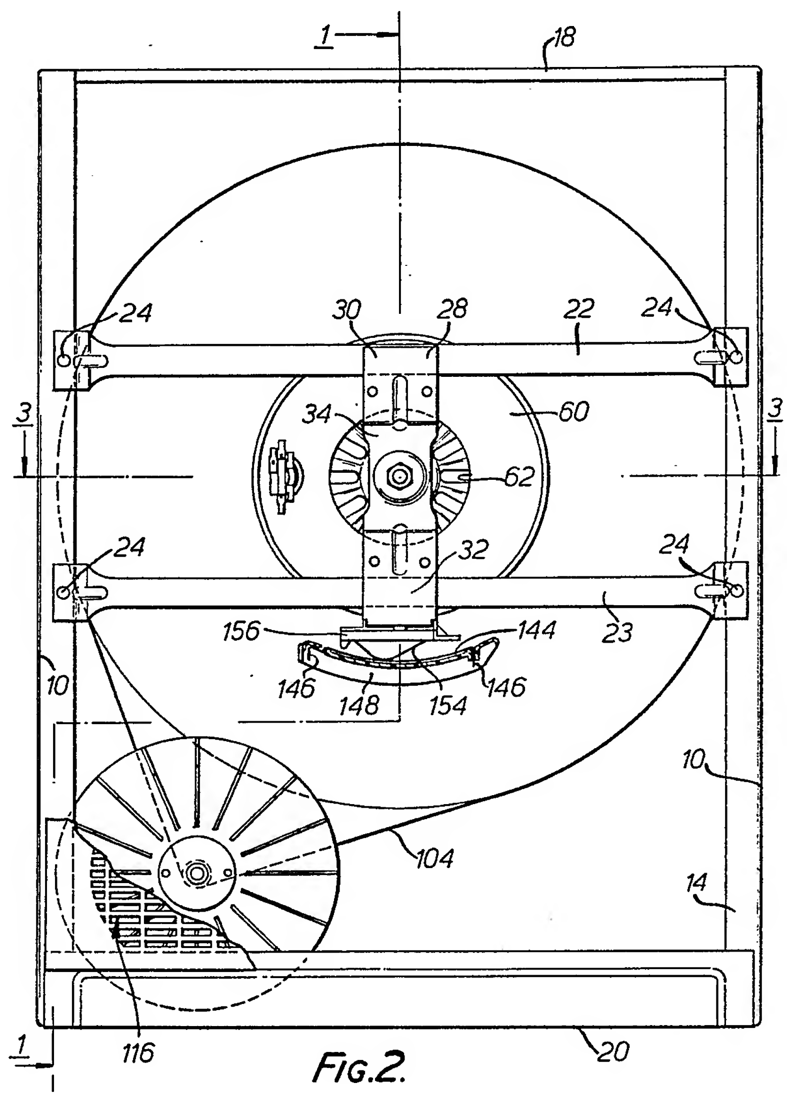

Fig.2.

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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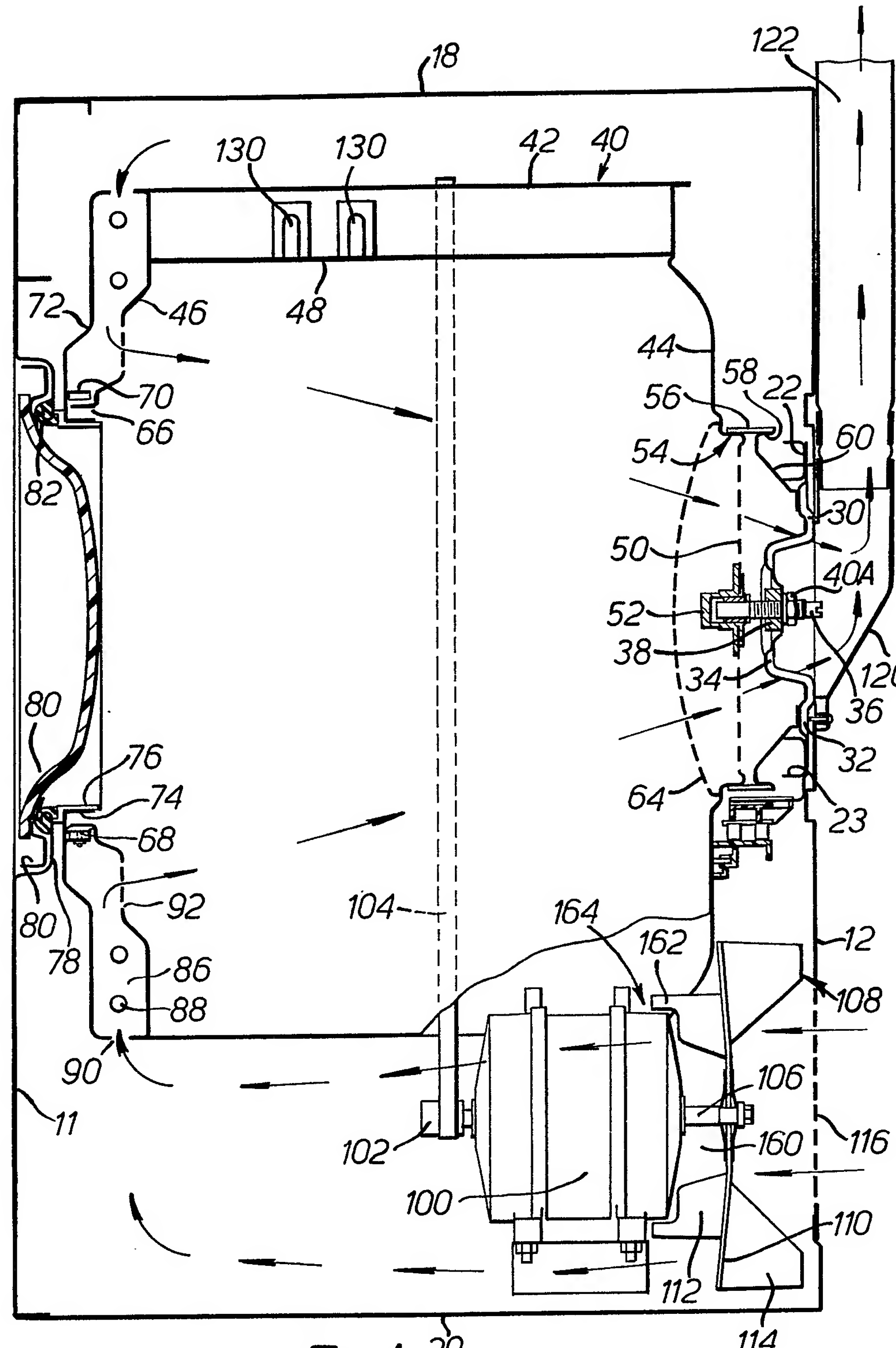
18
122
130
130
42
40
72
46
48
44
58
22
56
70
66
60
54
82
30
50
40A
52
38
34
120
36
80
76
74
32
64
23
68
80
78
92
104
164
162
12
86
88
108
90
106
11
102
160
116
100
110
112
114
20

FIG.1.

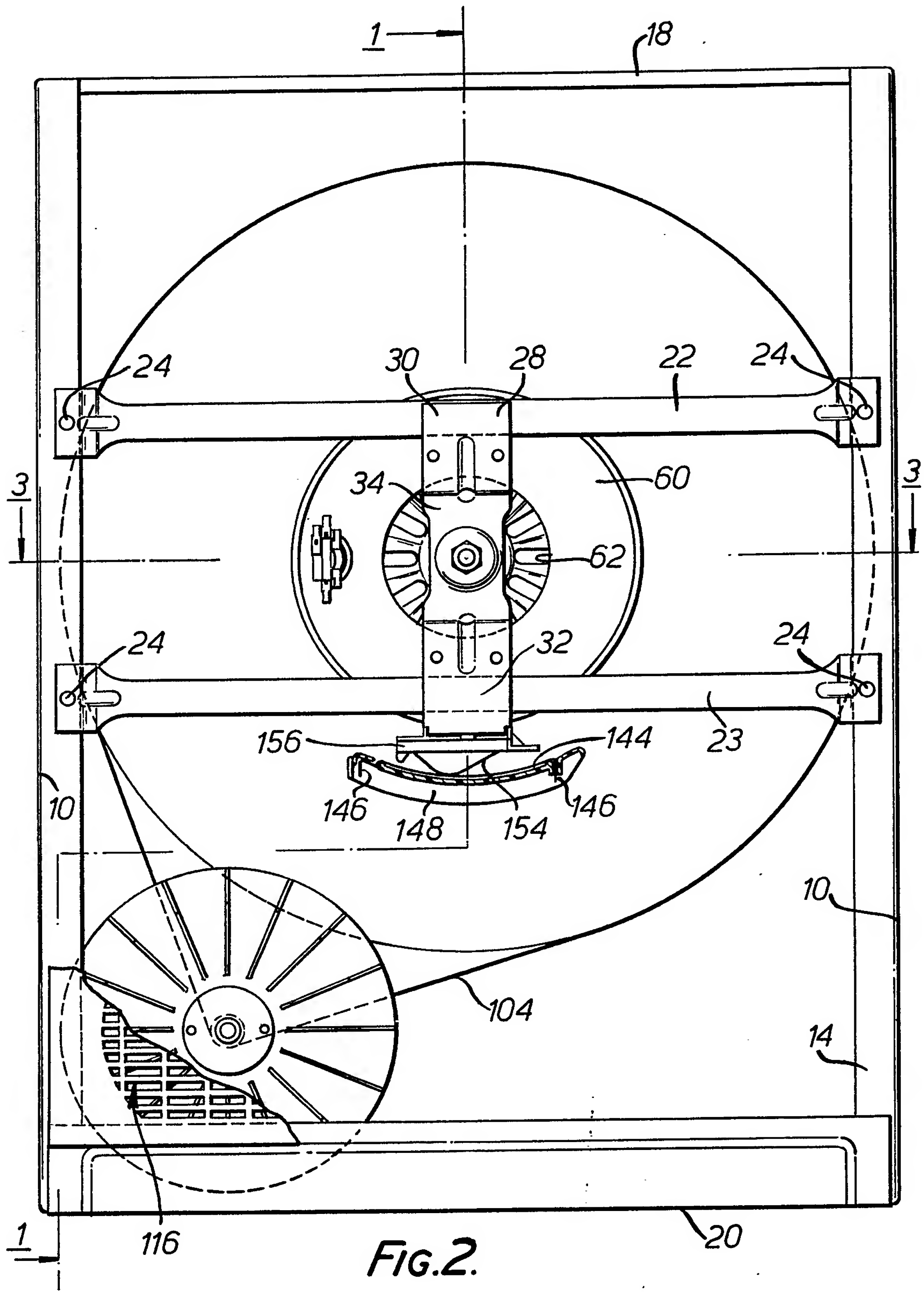
1
18
30
28
22
24
24
3
34
60
3
62
24
32
24
156
144
23
10
146
148
154
146
10
104
14
116
20
1

FIG.2.

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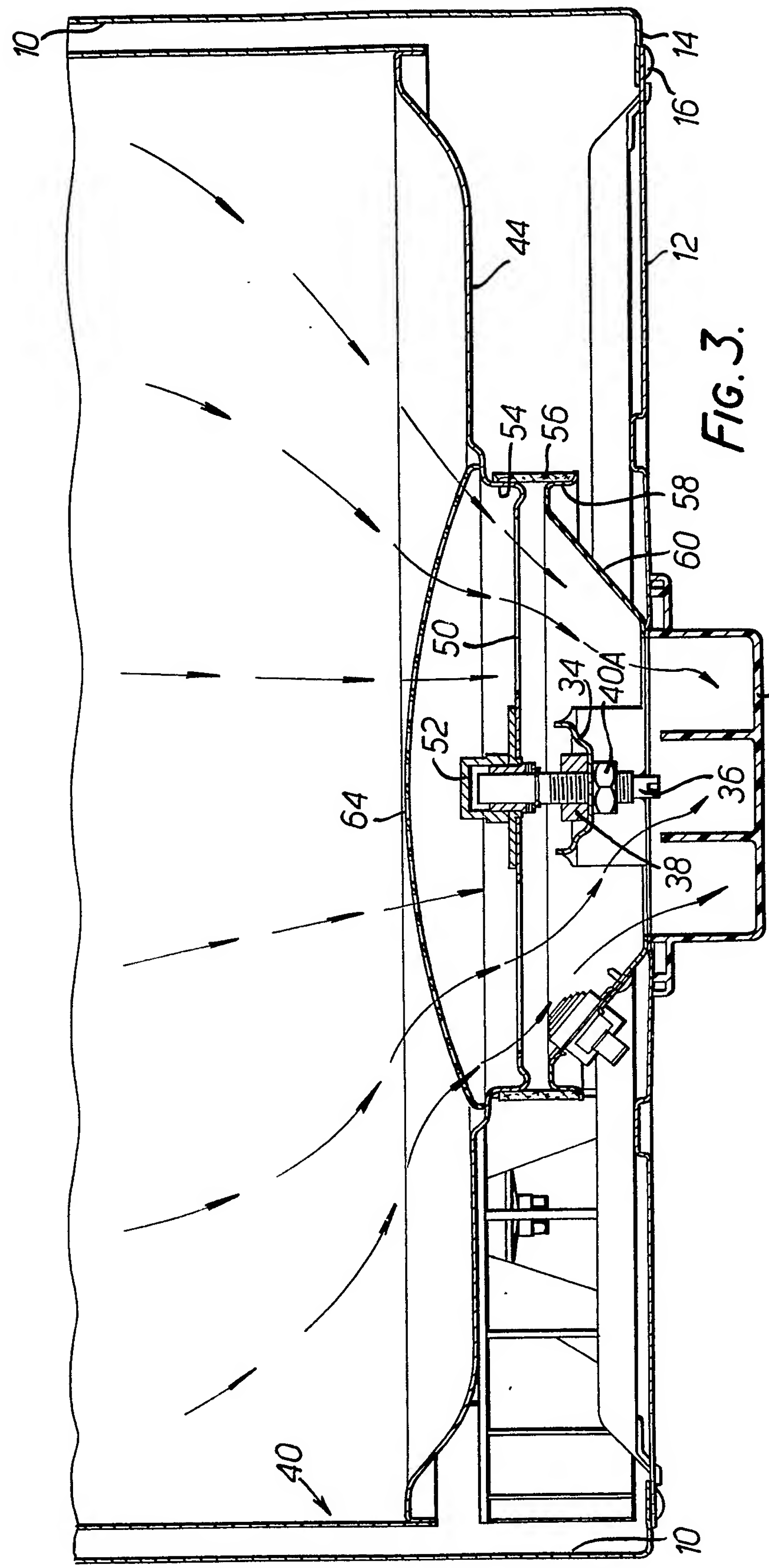


FIG. 3.

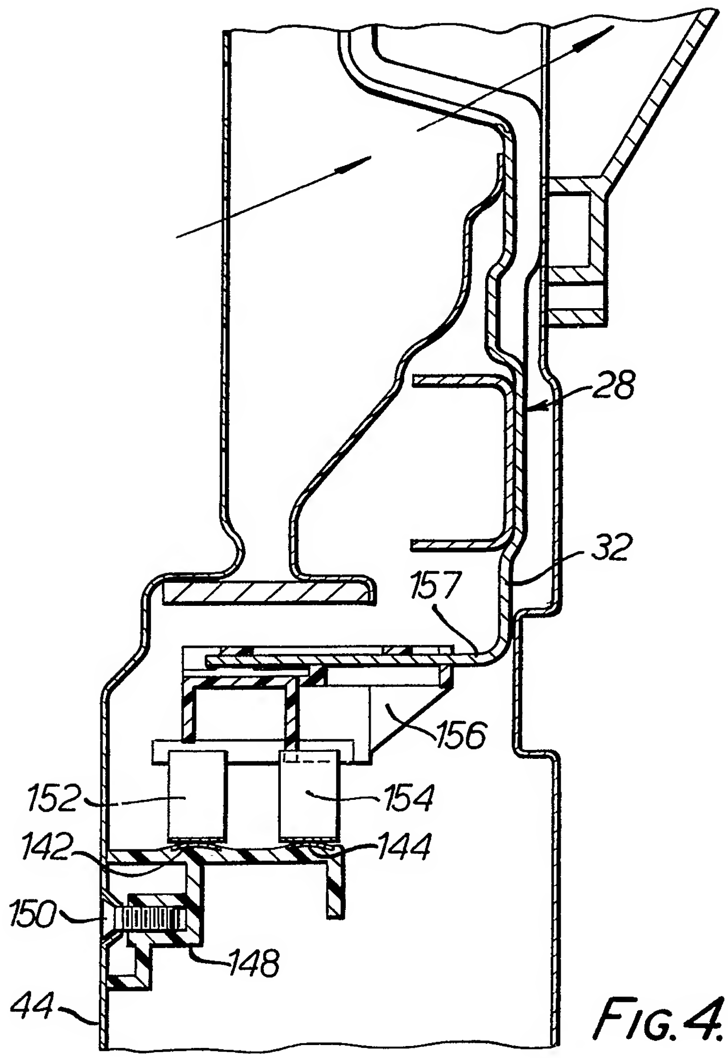

28
32
157
156
152
154
142
144
150
148
44

FIG. 4.

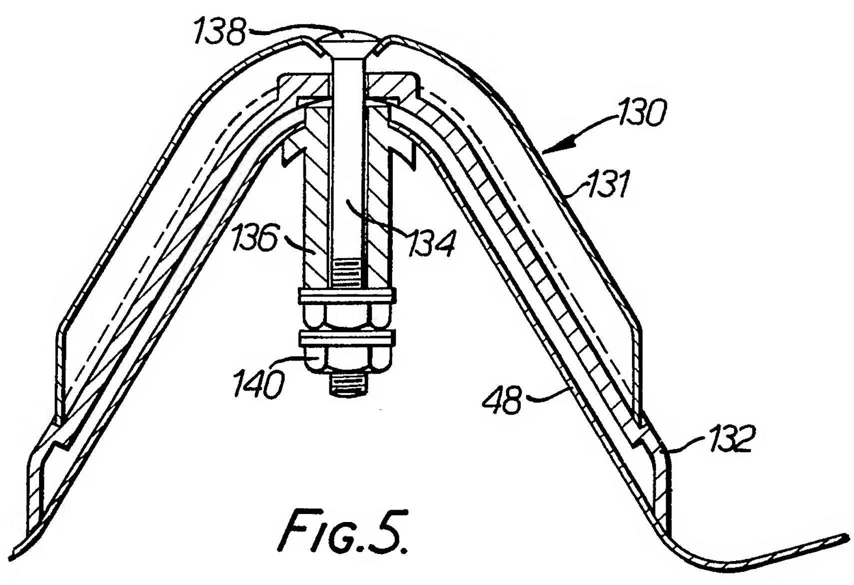

138
130
131
136
134
140
48
132

FIG. 5.

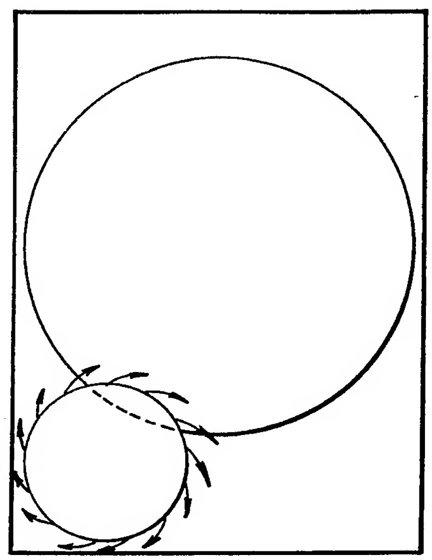


FIG. 6.

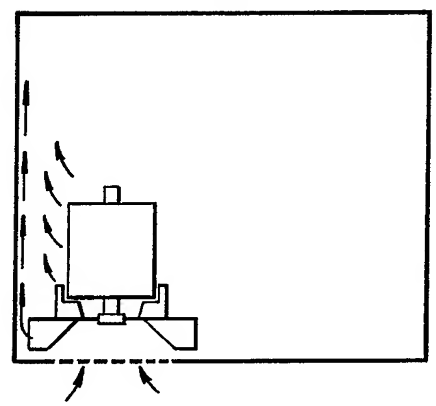


FIG. 7.

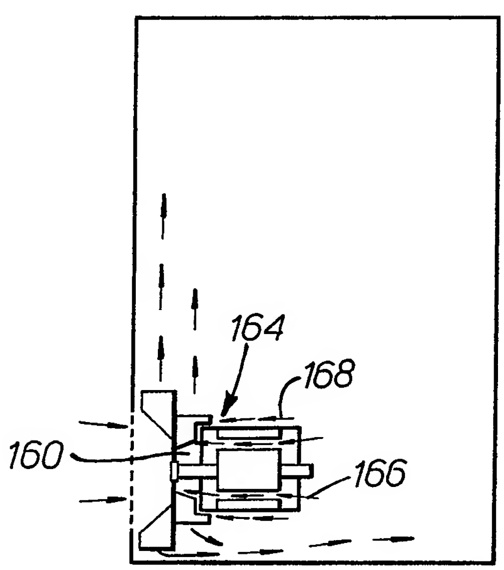
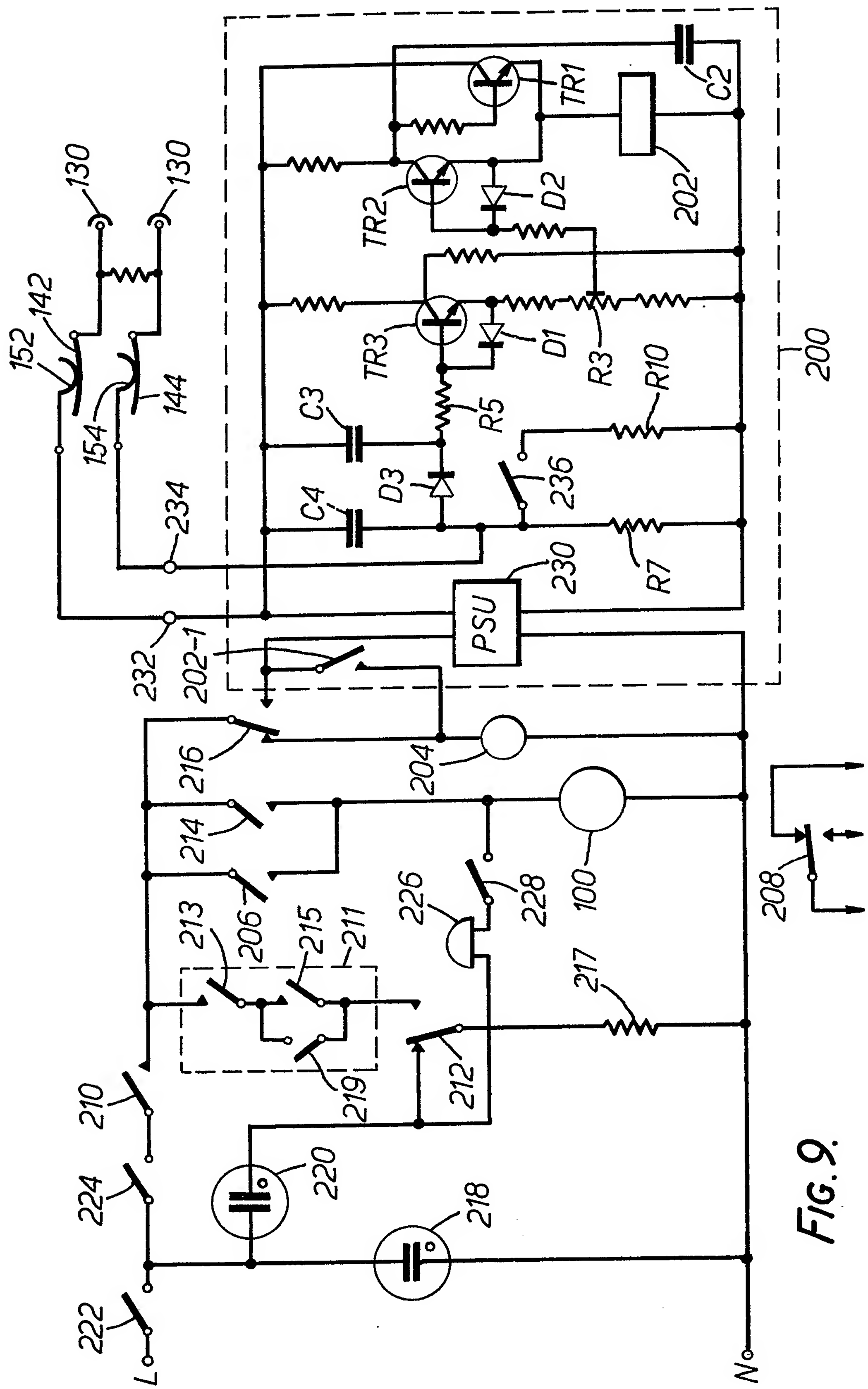


FIG. 8.



130
130
152
142
154
144
234
232
202-1
TR1
C2
TR2
D2
202
TR3
D1
R3
R10
200
C3
R5
C4
D3
236
R7
230
PSU
216
204
214
206
213
215
211
219
210
224
222
L
N
220
218
212
217
226
228
100
208

FIG. 9.

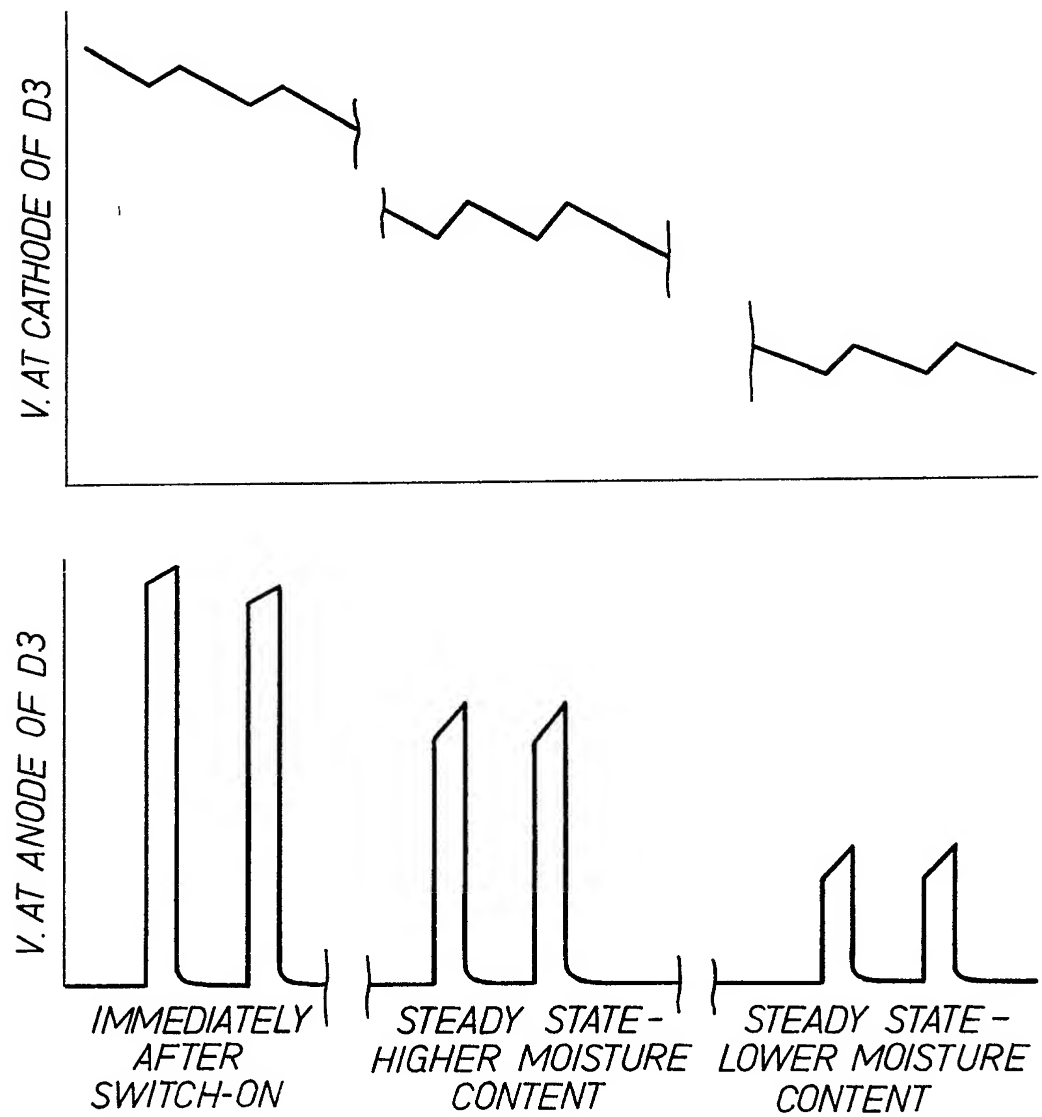

V. AT CATHODE OF D3
V. AT ANODE OF D3
IMMEDIATELY AFTER SWITCH-ON
STEADY STATE - HIGHER MOISTURE CONTENT
STEADY STATE - LOWER MOISTURE CONTENT

FIG. 10.

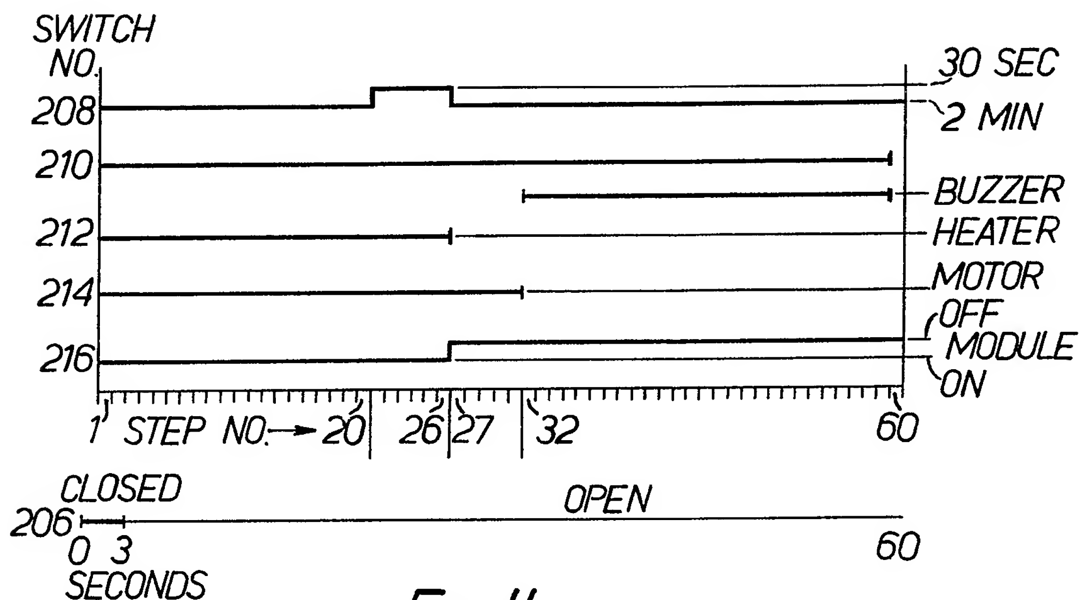

SWITCH NO.
208
210
212
214
216
30 SEC
2 MIN
BUZZER
HEATER
MOTOR
OFF
MODULE
ON
1
STEP NO.
20
26
27
32
60
CLOSED
OPEN
206
0 3
60
SECONDS

FIG. 11.

SPECIFICATION
Tumbler Dryers

This invention relates to tumbler dryers of the type comprising an outer casing, a clothes drum mounted within the casing for rotation about a horizontal axis, a motor mounted in the casing at least partially below the drum, a fan driven by the motor shaft and arranged to cause a flow of air via an inlet into the casing, through the drum and from the casing through an outlet. Such tumbler dryers are known in which control systems are provided which rely on the measurement of the electrical resistance of the clothes. For example, two probes may be insulated from one another and mounted in the drum and the resistance between the probes is measured using an electronic module. The probes normally rotate with the drum and they have to be connected to a stationary module using some form of sliding contact. Systems are known where contact between the drum contacts and the module takes place either continuously or over some portion of the drum revolution. The design of the electronic module is normally such that it responds to the period of contact between the probes and the clothes as well as to the resistance of the clothes.

Where the sliding contacts make continuous contact, some error is therefore introduced due to the inconsistency of the contact period between the clothes and the probes. The systems where intermittent contact between the probes and the module is made have the advantage that the position where contact is made at the sliding contacts can be selected to be the position where the clothes make contact with the probes most consistently. Variations in contact period are then reduced resulting in more accurate measurements.

The sliding contact system is usually placed on the periphery of the drum. For example, bus bars are mounted on the drum but they have to be at a sufficient height above the drum so that when the spring contacts do not rub against the bus bars, they do not touch the drum, a condition which would lead to false resistance readings unless the drum is lined with wear resistant insulating material. Tumbler dryers, however, are normally designed to have the largest possible drum consistent with given casing width and this restricts the height of the bus bars mounted on the drum periphery to the point where design compromises need to be made.

According to one aspect of the present invention, a tumbler dryer comprises an outer casing, a clothes drum mounted within the casing for rotation about a horizontal axis, a motor mounted in the casing at least partially below the drum, a fan driven by the motor shaft and arranged to cause a flow of air via an inlet into the casing, through the drum and from the casing through an outlet, the drum and casing having a space between their rear walls in which space are located co-operating stationary and moving dryness sensor contacts, the moving contact or contacts being mounted on the end of the drum facing said space and being connected to a dryness sensor or sensors located in the drum.

This solution which can place the contact system on either the front or the rear panel of the drum, depending on the overall dryer design, has the following advantages. Firstly, there is freedom from the space restriction described above where the system is located on the periphery of the drum. Secondly, the sliding contacts can be designed to have a reduced rotating radius thus reducing noise and wear and thirdly, the design gives scope for increased accuracy in the location of the spring contacts relative to the bus bars. This is particularly applicable in the construction where the sliding contacts are arranged on the rear panel of the drum and where the rear panel has a central bearing or shaft to provide the rear support for the drum. In this situation, the holes for fixing the bus bars and the drum centre support would be pierced in a single press operation resulting in more accurate radius of rotation for the bus bars than is possible when they are mounted on the periphery of the drum. Similarly the spring contacts may be mounted on the member which supports the drum at the rear and their fixings may be accurately dimensioned relative to the position of the drum shaft or bearing. This situation either reduces or eliminates the need for a radial adjustment of the spring contact relatively to the bus bars.

The or each moving contact may comprise an arcuate metallic strip of limited circumferential extent, the arc being struck about the horizontal axis and to provide for intermittent contact the arcuate strips preferably extends for approximately 30° around the axis.

Preferably a pair of stationary and a pair of moving contacts are provided, one of each pair being connected to a different one of a pair of sensor probes located in the drum. Conveniently the sensor probes are mounted on a paddle in the drum.

The outer casing may be substantially sealed, except for the inlet and outlet and the fan is arranged to pressurise the casing and cause air to flow from the inlet which is in the rear wall of the casing, forwardly around the drum, into the drum via a heater annulus, rearwardly through the drum and through the air outlet, the air outlet being situated in the rear wall of the casing in line with the axis of the drum.

The invention may be carried into practice in a number of ways but one specific embodiment will now be described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a sectional side elevation of a tumbler dryer according to the invention;

Figure 2 is a rear elevation of the tumbler dryer of Figure 1 with the rear panel removed and certain parts shown in section;

Figure 3 is a sectional plan of the rear part of the tumbler dryer of Figures 1 and 2, taken on the line 3—3 of Figure 2;

Figure 4 is an enlarged sectional side elevation of part of Figure 1 showing, in detail, the drum bus bars and spring contact arrangement for sensing the dryness of the clothes;

Figure 5 is a sectional view of one of the paddles of the drum of the tumbler dryer showing the manner of attachment of a probe for sensing the dryness of the clothes;

Figure 6 is a diagrammatic rear view of the tumbler dryer showing the air circulation;

Figure 7 is a top view with the drum removed showing air moving forwardly from the motor fan unit;

Figure 8 is a side view of the motor fan unit showing the air flow;

Figure 9 is a machine circuit;

Figure 10 shows the wave form voltage at two parts of the circuit, and

Figure 11 is a chart showing the operating sequence of a timer forming part of the machine.

The tumbler dryer shown in the drawings includes an outer casing of sealed construction in order to enable the interior of the casing to be pressurised in a manner to be described. Thus the casing includes a pair of side walls 10, seen in Figure 3, a front wall 11, a removable rear panel 12 secured to inturned flanges 14 of the side walls 10 by means of screws 16, a top 18 and a base 20.

Extending across the back of the casing, inside the rear panel 12, are a pair of horizontally disposed and vertically spaced supporting struts 22 and 23 which are secured by bolts 24 to the inturned flanges 14. For strengthening purposes, each of the transverse struts 22 and 23 is of generally U-shape as shown in Figure 1. Extending vertically between central regions of the transverse struts 22 and 23 is a vertical bearing support generally indicated at 28. This includes upper and lower vertically extending rearmost portions 30 and 32 respectively which are connected respectively to the two transverse struts 22 and 23. Between the portions 30 and 32 there is a forwardly positioned section 34 in which is mounted a horizontally extending drum mounting spindle 36. As shown in detail in Figure 3, this spindle is mounted by means of a screwed connection in an internally threaded collar 38 which is rigidly secured to the section 34. A lock nut 40A completes the spindle mounting. This screw threaded mounting enables axial adjustment of the position of the spindle in order to take up end slack in the mounting of a rotary drum generally indicated at 40. The precise details of this drum will now be described with particular reference to Figure 1. It includes a circular or peripheral wall 42, a rear wall 44 and a front wall 46. The drum has three horizontally extending paddles 48, of which one is seen in Figure 1, and by means of which clothes are lifted and dropped as the drum is rotated.

The rear wall 44 of the drum has a vertically extending perforated central portion 50 in which is centrally mounted a bearing 52 by means of which the rear end of the drum is mounted on the bearing spindle 36. The periphery of the central portion 50 of the rear wall 44 merges into an axial step 54. A felt seal 56 co-operates with the external surface of this step and also with an axially extending rim 58 of a generally frusto-conical partition 60, the rear face of which is seen in Figure 2, and which has a central aperture 62 through which the central section 34 of the vertically extending strut 28 extends. The aperture 62 also defines an exit path for air leaving the drum 40 rearwardly through the apertures in the central portion 50.

Disposed in front of the bearing 52 and connected to the rear wall 44 of the drum is a removable domed lint filter 64.

It is to be particularly noted that the rear wall 44 of the drum is spaced to a significant extent from the rear panel 12 of the casing, principally by the construction of the spindle mounting 36 and the surrounding frusto-conical partition 60. The space between the rear wall 4 of the drum and the rear panel 12 serves several useful purposes which will be discussed in more detail later.

As shown in Figure 1, at the front end of the drum, the front wall 46 has an axial flange 66 defining a loading opening to the drum. The flange 66 is supported by a number of spaced arcuately extending bearing supports 68 of which one is shown in figure 1. These are mounted on a similar axial flange 70 of a heater shroud 72 which is mounted in stationary manner between the front wall 46 of the drum and the front wall 11 of the casing. The shroud has a further axial flange 74 on which is mounted on a door liner ring 76 and which extends forwardly into abutment with an inset annular portion 78 of the front wall 11 of the casing. Mounted for hinging movement about a vertical axis in this region of the casing is a door 80 which engages a door seal 82 carried by the annular portion 78.

As shown in Figure 1, a heater annulus 86 is provided between the heater shroud 72 and the front wall 46 of the drum and an annular heater 88 is mounted in this annulus. The periphery of the heater shroud 72 is spaced slightly from the drum 48 to provide an annular air entry 90 for the passage of air from outside the drum 40 into the heater annulus 86. Inwardly of the heater, the front wall 46 of the drum is provided with perforations at 92 to allow air to pass rearwardly from the annulus 86 and through the drum and over the clothes in the direction of the arrows shown in Figure 1.

Mounted on the lower wall 20 of the casing in one corner of the casing is a horizontal axis shaded pole motor 100, the forward end of the shaft of which is carried a pulley 102 driving a belt 104 surrounding the drum 40. The rear end 106 of the motor shaft has mounted on it a fan generally indicated at 108 and which is formed as a plastics moulding. The fan has a back plate 110 on the forward side of which are mounted motor cooling blades 112 and on the rear face of which are mounted larger diameter casing-pressurising blades 114. In line with the fan, the rear panel 12

of the casing is provided with an inlet grille 116.

In operation, the blades 114 draw air horizontally into the casing through the grille 116 in the manner shown. The air is discharged centrifugally from the blades 114 and pressurises the whole of the casing. Air passes forwardly beneath the drum 40 as well as upwardly behind the drum and across the top of the drum in the manner shown by the arrows in Figure 1. The air passes into the drum via the annulus 90 and then rearwardly over the clothes, through the filter 64 and the perforated rear wall section 50 and thence through the central aperture 62 in the frusto-conical partition 60 to be discharged into a deflector 120 mounted on the rear of the rear panel 12. This deflector directs the air flow vertically, for example, into a duct 122, by which the exhaust air is transmitted to a suitable vent in order to avoid the moist air being discharged into the room in which the tumbler dryer is being operated.

Due to the continued use of the heater 88 during a drying cycle, there is a tendency for the whole machine to become heated and it is found that the air temperature between the casing and the drum is higher than ambient air outside the dryer. A rise of 15°C is typical. This gives rise to difficulties if this air is used in order to cool the motor and therefore in this construction steps are taken to ensure that the motor is cooled by air very shortly after it is drawn into the casing and prior to the time it becomes heated up due to heat transfer from the heater, the drum etc. Apart from Figure 1, Figures 6, 7 and 8 also show the direction of air flow caused by the fan 108. The main blades 114 cause a radial type of flow shown in Figure 6. Due to the positioning of the motor fan unit in one corner of the casing, air is discharged also in the manner shown in Figure 7 along one side of the casing and also below the motor, as shown in Figures 1 and 8. The motor cooling fan blades 112 also cause an outward flow which induces a low pressure in the region 160 around the shaft 106, as shown in Figures 1 and 7. It will be seen that the fan blades 112 have tip portions 162 arranged closely to overlie the rear end of the motor 100 and these tend to cause a low pressure in the region 164. As a consequence a rearwardly directed flow of air is caused both through the motor, in the direction indicated by the arrows 166 in Figure 8 and around the periphery of the motor as indicated by the arrows 168 in Figure 8. These two flows of air tend to draw air from a supply of air which has just passed forwardly from the fan and as a consequence this air is still relatively cool, if not still at ambient temperature. As a consequence satisfactory cooling of the motor unit is ensured by air which is not substantially, if at all, heated by heat transfer from the drum and the heater.

It is to be particularly noted from Figures 1 and 2 that the external diameter of the blades 114 of the fan is greater than the space below the drum 40 within the casing and as a result, it is arranged that the blades 114 extend into the space formed between the rear wall 44 of the drum and the rear panel 12 of the casing. This enables the relatively large diameter blades 114 of the fan to be used and thereby enables the production of adequate pressures and air flow within the system against the resistance of the venting hose or ducts or a partially blocked lint filter without sacrificing the rating of the heater which, in this example is 2.5 kW. This is in contrast to certain prior proposals in which the diameter of the fan has had to be such that it will fit below the drum so causing a reduction in air flow with the result that, in order to overcome the back pressures due to venting hoses or the like and blocked filters, the heater rating has had to be reduced to 1.7 kW or less which is well below average. This of course results in extended drying times for the dryer as a whole.

Control means is provided between the interior of the drum and a circuit of the machine for the purpose of controlling the dryness of the clothes dried by the machine. Basically the system includes spaced probes within the drum of the machine which are periodically connected to the circuit in a manner to be described. The variation of resistance between the probes controls an initial period of heating of an untimed nature. Eventually the probes and circuit sense a dryness of the order of 15% whereafter a manually determined timed period of heating occurs to complete the drying of the clothes to the required dryness.

Referring to Figure 1, the interior of the drum has three equally spaced longitudinal paddles 48, of which one is shown, and mounted on one of these paddles are a pair of spaced probes 130 each of which is of the form shown in detail in Figure 6. Thus each probe comprises a generally V-shaped metallic element 131 mounted on an insulating mounting element 132 and secured in position on the paddle 48 by means of a bolt 134 extending through a plastics mounting sleeve 136 on the outside of the paddle 48. The bolt has a head 138 by which the metallic element 131 of the probe is electrically connected to a terminal 140 on the outer end of the bolt 134 and by which the probes are connected in the circuit in a manner to be described with reference to Figure 9. Since the probes 131 are obviously rotating with the drum, it is necessary to provide a pickup arrangement which is located in the space between the rear wall 44 of the drum and the rear panel 12 of the casing in the manner shown in Figures 1, 2, and 4. The terminals 140 of the two probes 131 are respectively connected by leads (not shown) to a pair of arcuate bus-bars 142 and 144 each of which comprises an arcuate strip of stainless steel, the arc of which is struck about the axis of the rotary drum, each strip having a pair of inturned ends 146 by means of which it is mounted on an insulating mounting block 148 secured to the end wall 44 of the drum by means of screws 150 shown in Figure 4. It will be seen from Figure 4 that the two bus-bars 142 and 144 are axially spaced from one another and these co-

operate with rotary spring contacts 152 and 154 respectively. It will be seen that the contacts 152 and 154 are mounted on a further insulating mounting block 156 which is secured to an axially extending flange 157 extending forwardly from the lower vertically rearmost portion 32 of ths bearing support 28, as shown in Figure 4.

In order to illustrate how the variation of resistance between the probes 130 controls the operation of the machine, Figure 9 illustrates the relevant parts of the circuit of the machine, while Figure 10 illustrates the waveforms occurring at various points in the circuit, and Figure 11 illustrates, in chart form, the operating sequence of a timer forming part of the machine.

The circuit of the machine includes a sensing circuit 200 which is connected to the probes 130, and which controls a relay 202 which has a single normally-open contact 202-1. As long as the laundry in the drum of the dryer has a moisture content of more than about 15%, the relay 202 remains unoperated, and the timer, which is driven by a timer motor 204, remains de-energised. During this phase, of course, the motor 100 and the heating element 217 are energised. When the moisture content of the laundry has fallen to about 15%, the relay 202 is energised, and the timer motor 204 is energised through contact 202-1, so that the timed part of the operating cycle of the machine now begins.

During this part of the operating cycle, the energisation of the motor 100 and the heating element 217 is continued for a period which is preset by the user, and may be up to about 43 minutes. After this period has elapsed, the heating element 217 is deenergised, but the motor 100 continues to run for a further 10 minutes, cooling the laundry in the drum. This completes the main part of the cycle, and the laundry should now be dried to the required degree. The remaining part of the cycle lasts for about 1 hour, during this part of the cycle, the motor 100 is energised briefly, once every minute, to tumble the laundry, and help to prevent creases developing. The laundry can, of course, be removed at any time during this last phase, since it is already dry.

The details of the operation of the sensing circuit will be described later.

The timer has a first cam which rotates steadily at 1 r.p.m. for as long as the timer motor 204 is energised, and controls a switch 206, as Figure 11 shows, the switch 206 is closed for 3 seconds during each revolution of the cam. This switch 206 controls the intermittent energisation of the motor 100 during the final part of the machine cycle. The timer also has five other cams, which rotate together in 60 steps of 6°C, and control five switches 208, 210, 212, 214 and 216. The switch 208 controls the period between steps taken by the cams; by means not shown in the drawings; as Figure 11 shows, for most of the time, the period between steps is 2 minutes, but from step 21 to step 26, the period between steps is only 30 seconds. The group of five cams is connected to a control knob, by means of which the cams may be advanced manually to any required position.

The switch 210 controls the power supply to most parts of the machine, although two neon indicator lights 218 and 220 take their supply directly from the mains, not through the switch 210. The switch 210 is closed in all positions of the timer cams except the last step, step 60, so that it isolates the main parts of the machine, including the timer motor 204, when the machine cycle has been completely finished.

The switch 212 controls, primarily, the heating element 217, the switch 214 controls the motor 100, which rotates the drying drum, and the switch 216 controls the timer motor 204, jointly with the sensing circuit 200.

In operation, the machine is started by closing a mains supply switch 222, closing the door of the machine, so that a microswitch 224 operated by the door is closed, and advancing the group of five timer cams, which should have stopped at step 60 at the end of the previous cycle, to a position somewhere between step 1 and step 26, depending on the required dryness of the laundry. Closing of the switch 222 directly energises the indicator light 218, indicating that the machine is "on". Closing of the microswitch 224 and the time switch 210 supplies power through a thermostat arrangement 211 which includes high and low temperature thermostatically controlled contacts 213 and 215 respectively and a High/Low selector switch 219, and through the switch 212 to the heating element 217. The switch 212 is a three-position switch, being a change-over switch with a central "off" position; for any cam position from step 1 to step 26, the switch 212 is closed to supply power to the heating element 217, but the heating element is de-energised for all later cam positions. During a final part of the cycle, the switch 212 provides an alternative conductive path, whose function will be explained later.

Closing of the microswitch 224 and the timer switch 210 also supplies power, through the switch 214, to the motor 100; the switch 214 is closed for all cam positions from step 1 to step 31. Thus, it will be seen that, until the group of cams passes step 26, the heating element 217 and the motor 100 will be continuously energised (subject to control of the heating element by the thermostat arrangement) and drying of the laundry will proceed in the normal way.

As explained above, the timer motor 204 does not run until the moisture content of the clothes has fallen to about 15%. The final dryness of the laundrry is set by suitably manually setting the timer cams, thereby setting the time which elapses from the time when the timer motor is energised until the timer passes step 26. On passing step 26, the heating element is de-energised and the heating phase of the cycle terminates.

The termination of the heating phase is controlled by a combination of resistance sensing and timing, rather than resistance sensing alone,

because the change in resistance with change in moisture content is much larger at 15% moisture content than when the laundry approaches total dryness. Also, the moisture content is decreasing fairly rapidly in the range just below 15%; this is the reason for arranging that the timer steps more rapidly during steps 21 to 26. An error of one step in the manual setting of the timer cams would have a considerable effect on the final dryness of the laundry if it resulted in the heating phase being continued for 4 minutes instead of 2 minutes after the timer motor 204 begins to run. For longer timer periods, corresponding to lower moisture contents, an error of 2 minutes can be tolerated. The maximum period before the timer passes step 26 is about 40 minutes.

After step 26, the motor 100 continues to rotate the drum, and the fan 108 blows cool air into the drum, cooling the laundry. On passing step 31, after a further 10 minutes, the switch 214 opens to de-energise the motor 100. At the same time, the switch 212 closes the alternative conductive path mentioned above. This path connects the indicator light 220 to the neutral side of the supply, through the heating element, so that the light glows to indicate that the laundry is ready.

The switch 206 is connected in parallel with the switch 214, to control the main motor 100. Obviously, this has no effect as long as the switch 214 is closed, but, once the switch 214 has opened, the switch 206 will have the effect of energising the motor 100 for 3 seconds every minute. This will tumble the laundry briefly, and help to prevent creases forming.

A buzzer 226 is connected, in series with an on/off switch 228, between the neutral side of the indicator light 220 and the live side of the main motor 100. Thus, once the indicator light 220 is on, indicating that the laundry is ready, closing of the switch 206 to energise the motor 100 will also briefly sound the buzzer 226, signalling that the laundry is ready. If the buzzer alarm is not required, the switch 228 is opened.

This stage of the cycle, with intermittent tumbling, will continue for about 60 minutes, after which the timer cams will have reached position 60, and the timer motor 204 will stop.

The sensing circuit 200 is supplied with power through the switch 216 for all cam positions from step 1 to step 26. A power supply unit 230 provides a low voltage d.c. supply from the power supplied through the switch 216. The sensing circuit 200 consists essentially of a capacitor C3, the voltage across which varies in accordance with the moisture content of the laundry, a sensing transistor TR3 which monitors the voltage across the capacitor C3 and a Schmitt trigger circuit controlled by the transistor TR3, and including transistors TR1 and TR2, in whose common emitter leads the relay coil 202 is connected.

In operation, the probes 130 are connected, for a fixed period during each revolution of the drying drum, to two terminals 232 and 234 of the sensing circuit. During this period, the resistance of the laundry in contact with the probes forms, with a resistor R7, a potential divider connected across the d.c. power supply. The mid-point of this potential divider is connected, through a diode D3, to the capacitor C3. When the probes 130 are not connected to the terminals 232 and 234, the diode D3 is reverse biassed, and the voltage on the capacitor C3 falls slowly, because this capacitor is connected through a large resistor R5 to the base of the transistor TR3. During the period when the probes 130 are connected to the terminals 232 and 234, the diode D3 is forward biassed, and a small current flows into the capacitor C3, raising its voltage again, to an extent which depends on the resistance of the path between the probes 130. Thus, the voltage on the capacitor C3 will be a sawtooth, and, under steady conditions, the upper and lower limits of the voltage excursion will be directly related to the resistance between the probes 130 and therefore to the moisture content of the laundry.

The transistor TR3 has an emitter resistor formed by a potentiometer R3, whose slider is connected to the base of the transistor TR2, which forms the input of the Schmitt trigger. As long as the moisture content of the laundry is more than about 15%, the voltage at the slider of the potentiometer R3, which follows the voltage on the capacitor C3, will never fall low enough to turn off the transistors TR2. The values of the resistors in the Schmitt trigger circuit are so selected that the resulting current through the transistor TR2 is insufficient to operate the relay 202. However, when the moisture content has fallen below about 15%, the lower limit of the voltage excursion on the capacitor C3, as repeated by the transitor TR3, will e low enough to turn off the TR2 and turn on the transistor TR1. The current in the transistor TR1 is sufficient to operate the relay 202, so that the timer motor 304 begins to run, as described above.

Once the Schmitt trigger has switched, as described above, the relay 202 will remain operated until the power supply is removed from the sensing circuit 200. This will occur when the timer can pass step 26; after this step, the switch 216 supplies power directly to the timer motor 204, ensuring that the timer completes its cycle.

Because the capacitor C3 is returned to the positive power supply line, the transistor TR3 will be turned fairly hard on when the power supply is restored this ensures that, when the machine is restarted, the relay 202 will be unoperated.

The sensing circuit 200 also includes a resistor R10, which, by closing a switch 236, can be connected in parallel with the resistor R7. This changes the moisture content at which the relay 202 will operate to perhaps 30%, so that it is possible to dry laundry to "iron dryness', that is to say, a moisture content somewhere between 15% and 30%.

The sensing circuit 200 also includes various components, such as capacitors C4 and C2, and

diodes D1 and D2, which serve to suppress interference, or to protect the junctions of the transistors. These components are not essential for an understanding of the operation of the circuit.

Claims

1. A tumbler dryer comprising an outer casing, a clothes drum mounted within the casing for rotation about a horizontal axis, a motor mounted in the casing at least partially below the drum, a fan driven by the motor shaft and arranged to cause a flow of air via an inlet into the casing, through the drum and from the casing through an outlet, the drum and casing having a space between their rear walls in which space are located co-operating stationary and moving dryness sensor contacts, the moving contact or contacts being mounted on the end of the drum facing said space and being connected to a dryness sensor or sensors located in the drum.

2. A tumbler dryer as claimed in Claim 1 in which the/or each moving contact comprises an arcuate metallic strip of limited circumferentialy extent, the arc being struck about the horizontal axis.

3. A tumbler dryer as claimed in Claim 2 in which the arcuate strip extends for approximately 30° around the axis.

4. A tumbler dryer as claimed in any one of the preceding claims including a pair of stationary and a pair of moving contacts, one of each pair being connected to a different one of a pair of sensor probes located in the drum.

6. A tumbler dryer as claimed in any one of the preceding claims in which the outer casing is substantially sealed except for the inlet and outlet and the fan is arranged to pressurise the casing and cause air to flow from the inlet which is in the rear wall of the casing, forwardly around the drum, into the drum via a heater annulus, rearwardly through the drum and through the air outlet, the air outlet being situated in the rear wall of the casing in line with the axis of the drum.

7. A tumbler dryer as claimed in any one of the preceding claims in which the fan extends partially into the said space.

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ABSTRACT:

A tumbler dryer has a clothes drum mounted to rotate in a casing about a horizontal axis. The drum is driven by a motor mounted in the casing at least partially below the drum. The drum and casing have a space between their rear walls and in this space are located co-operating stationary and moving dryness sensor contacts. The moving contact is mounted on the end of the drum facing the space and is connected to a dryness sensor or

sensors located in the drum.